Abstract Submitted
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Modeling variable density turbulence in the wake of an air-entraining transom stern[1] KELLI HENDRICKSON, DICK YUE, Massachusetts Institute of Technology — This work presents *a priori* testing of closure models for the incompressible highly-variable density turbulent (IHVDT) flows in the near wake region of a transom stern. This three-dimensional flow is comprised of convergent corner waves that originate from the body and collide on the ship center plane forming the "rooster tail" that then widens to form the divergent wave train. These violent free-surface flows and breaking waves are characterized by significant turbulent mass flux (TMF) at Atwood number $At = (\rho_2 - \rho_1)/(\rho_2 + \rho_1) \approx 1$ for which there is little guidance in turbulence closure modeling for the momentum and scalar transport along the wake. To whit, this work utilizes high-resolution simulations of the near wake of a canonical three-dimensional transom stern using conservative Volume-of-Fluid (cVOF), implicit Large Eddy Simulation (iLES), and Boundary Data Immersion Method (BDIM) to capture the turbulence and large scale air entrainment. Analysis of the simulation results across and along the wake for the TMF budget and turbulent anisotropy provide the physical basis of the development of multiphase turbulence closure models. Performance of isotropic and anisotropic turbulent mass flux closure models will be presented.

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